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subjecting said contact plug to a temperature sufficient to anneal said barrier layer.

REMARKS

The Applicants have carefully considered this application in connection with the Examiner's Action and respectfully request reconsideration of this application in view of the foregoing amendment and the following remarks.

The Applicants originally submitted Claims 1-23 in the application. The Applicants have amended Claims 1 and 12, and have canceled Claims 3 and 13. Furthermore, the Applicants have added Claim 24, which is supported by the specification and does not add any new matter. Accordingly, Claims 1-2, 4-12 and 14-24 are currently pending in the application.

I. Formal Matters and Objections

The Examiner has objected to the drawings as being informal. The Applicants request that the Examiner hold the objection in abeyance until such time as the Examiner indicates allowable subject matter.

The Examiner has also objected to the specification under 37 CFR 1.71 because the specification does not enable the subject matter of Claim 23. In response thereto, the Applicants have amended the specification to specifically include the subject matter of Claim 23. Therefore, the Applicants respectfully request that this rejection be withdrawn.

II. Rejection of Claim 23 under 35 U.S.C. §112

The Examiner has rejected Claim 23 under 35 U.S.C. §112, first paragraph for the same reasons as set forth above with respect to the specification. As stated above, the Applicants have amended the specification to fully enable the subject matter of this claim. Therefore, the Applicants respectfully request that this rejection be withdrawn.

III. Rejection of Claims 1-6, 8-17 and 19-22 under 35 U.S.C. §103

The Examiner has rejected Claims under 35 U.S.C. §103(a) as being unpatentable over the Applicants admitted prior art and in view of U.S. Patent No. 5,827,777 to Schinella, et al (Schinella) in combination with U.S. Patent No. ^{wrong} 5,462,895 to Chen (Chen) and U.S. Patent No. 5,741,725 to Inoue, et al. (Inoue). As the Examiner is no doubt aware, determination of obviousness requires consideration of the invention considered as a whole; the inquiry is not whether each element exists in the prior art, but whether the prior art made obvious the invention as a whole. Furthermore, there must be some suggestion or teaching in the art that would motivate one of ordinary skill in the art to arrive at the claimed invention; a reference that teaches away from a claimed invention strongly indicates nonobviousness.

Moreover, to establish a prima facie case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicant's disclosure.

The Applicants respectfully submit that the references relied on by the Examiner are improperly combined, and even if combined, they do not teach the presently recited inventions. Schinella is directed to a process for producing a relatively thin titanium nitride (TiN) barrier layer in a contact opening of an integrated circuit. Schinella recognizes the problems associated with the use of tungsten hexafluoride and its effect on the TiN layer within a contact structure. (Col. 3, lines 12-29). Schinella addresses this problem, however, by proposing a method of depositing a very thin layer (e.g., thickness ranging from 50 Å to 200 Å) of TiN. As noted by the Examiner, however, Schinella does not teach or suggest a step that anneals the Ti/TiN layer after the contact plug formation, which is not surprising since, Schinella addresses the problem by depositing a very thin TiN layer.

Chen, on the other hand, is directed to a chemical vapor deposition method of forming an adhesive layer for a blanket layer that includes a Ti film, a Ti-rich TiN film or a titanium silicide (TiSi_x) film or a TiN (stoichiometric) film within a contact opening. The Ti film, Ti-rich TiN film or the TiSi_x film is annealed to be converted into a TiSi_2 film (Abstract). It is important to note that Chen uses chemical vapor deposition in all embodiments to achieve the desired amount of deposition. The flow rates that are needed to obtain the proper stoichiometric TiN film are carefully and specifically taught. Furthermore, there is no teaching or suggestion of using another type of deposition technique to achieve the proposed deposition scheme. (Col. 2, lines 15-32 and lines 55-66 and Col. 3, lines 39-54). In fact, the use of chemical vapor deposition is so important to Chen's invention that independent claim 1 even requires the use of chemical vapor deposition.

The presently claimed inventions are directed to a method of improving the quality of the barrier layer by depositing the barrier layer with physical vapor deposition and annealing the

barrier layer after the contact plug is formed. Given the present claims, one who is skilled in the art would not combine the teachings of Schinella and Chen for at least two reasons. First, Schinella addresses the problem of the present invention by the deposition of a very thin film of TiN. Thus, there is no reason for one skilled in the art to combine Schinella with Chen because the post contact plug anneal as taught in Chen is not necessary in view of the complete way that Schinella addresses the TiN layer quality problem. Second, as noted above, chemical vapor deposition is the only deposition technique taught or suggested by Chen. Therefore, there is no motivation provided, absent some teaching or suggestion to the contrary, of changing the chemical vapor deposition process taught by Chen to the sputtering process taught by Schinella.

Additionally, even if one were to combine the teachings, the only combination that is consistent with the teachings or suggestions of both references is to use chemical vapor deposition processes to form the respective barrier layers because including physical vapor deposition in Chen is inconsistent with its clear teachings as stated above. If the references are so combined, there is no teaching or suggestion of each element of Claims 1 and 12. Inoue fails to cure the deficiencies of Schinella and Chen because Inoue simply teaches or suggest the formation of a titanium silicide layer over a gate structure and does not teach or suggest the combined elements of either Claim 1 or Claim 12.

Thus, the references in combination fail to establish a prima facie case of obviousness with respect to Claims 1 and 12 because they are either improperly combined or when combined to be consistent with the teachings of Schinella and Chen, they fail to teach or suggest each element of Claims 1 and 12.

In view of the foregoing remarks, the cited references do not support the Examiner's rejection of Claims 1-2, 4-12 and 14-24 under 35 U.S.C. §103(a). The Applicants therefore respectfully request the Examiner withdraw the rejection.

IV. Conclusion

In view of the foregoing amendment and remarks, the Applicants now see all of the Claims currently pending in this application to be in condition for allowance and therefore earnestly solicit a Notice of Allowance for Claims 1-2, 4-12 and 14-24.

The Applicants request the Examiner to telephone the undersigned attorney of record at (972) 480-8800 if such would further or expedite the prosecution of the present application.

Respectfully submitted,

HITT CHWANG & GAINES, P.C.

A handwritten signature in black ink, appearing to read "Greg Parker", written in a cursive style.

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